

TS98-403C
Serial number 09/285,986

REMARKS

Examiner Nema O. Berezny is thanked for thoroughly examining the Prior Art.

Favorable reconsideration of this application in light of the above amendments and the following remarks is respectfully requested.

The invention teaches the deposition of a pattern of interconnecting lines and bond pads. Passivation layers are deposited over this metal pattern. A layer of photosensitive polyimide is deposited over the passivation layers. This layer of photosensitive polyimide is patterned, exposed and developed, the passivation layer is patterned and etched to expose the underlying bonding pads. The remaining polyimide is cured and cross-linked and remains in place to serve as a buffer during further device packaging.

Claim rejections - 35 U.S.C. § 103

Reconsideration of the rejection of claims 1-25 and 27-30 under 35 U.S.C 103(a) as being unpatentable over Dass et al. (US

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Patent 6,143,668) in view of Fu et al. (US Patent (5,807,787) is respectfully requested based on the following.

As a brief overview of the instant invention, the instant invention:

- starts with the surface of a semiconductor substrate, over which a pattern of metal has been created, including interconnect lines and bonding pads
- a first and second layer of passivation are consecutively deposited
- a thick layer of polyimide is deposited over the surface of the second layer of passivation
- the thick layer of polyimide is patterned and etched creating openings in the layer overlying the surface of the bonding pads, leaving the polyimide in place above the interconnect line pattern
- the layers of passivation are etched, exposing the surface of the bonding pads, and
- the thick layer of polyimide is cured and cross-linked in order to provide improved protection for the interconnect metal.

Dass et al. starts with a surface over which a bonding pad is provided. No pattern of metal interconnect lines has been created over the substrate used by Dass et al. The invention addresses a surface over which interconnect lines are created adjacent to a bond pad, allowing the creation of an opening to the bond pad while adjacent layers of interconnect are protected from etching effects. Dass et al. therefore does not provide for the problem of surface damage to the passivation layer of interconnecting metal lines. Dass et al. has not addressed the occurrence of keyholes between closely spaced layers of interconnect metal.

Since Dass et al. does not provide for a thick layer of polyimide overlying interconnect traces Dass et al. also does not provide for protection of the passivation film (by the thick layer of polyimide) that remains in place above the interconnecting lines.

The method that is provided by Dass et al. addresses problems that are experienced with a passive scrub cantilever needle probe card and the scrubbing process, problems that become particularly acute for smaller contact pad pitch for contact pads that are used for testing or probing of wafers. The pads

that are therefore created by Dass et al. are wafer contact pads for testing purposes having a pitch of about 80 microns.

Fu et al. addresses only bond pads, the instant invention addresses bonding pads that are provided on the surface of a substrate concurrent with interconnect lines.

This latter difference is significant since, in forming a thick layer of passivation (for improved protection of the underlying components) in the era of sub-micron devices and the therewith used closely spaced interconnect lines, keyholes between interconnect lines are a problem since the thick layer of passivation (typically deposited by depositing two layers of passivation) does not readily penetrate between narrowly spaced adjacent interconnect lines.

For a typical process of etching a layer of passivation in order to expose a bonding pad, photoresist is used which, where keyholes are present (typically between adjacent interconnect traces), penetrates the keyholes and, during subsequent high temperature processing, violently reacts to the high temperatures and "explodes" from the keyholes, causing significant disturbance to the process of device formation.

This latter effect must be prevented. The present invention prevents this by using a thick layer of polyimide whereby the polyimide readily penetrates any keyholes that may have formed between adjacent, closely spaced interconnect lines. With the invention, bond pads can be created without incurring processing damage by photoresist remnants that in conventional processing penetrates into keyholes between closely spaced interconnect lines.

Fu et al. deposits a layer of passivation and etches this layer (exposing the surface of the bonding pad) before depositing a layer of polyimide. The instant invention deposits the (two layers of) passivation over which the layer of polyimide is deposited. After these layers have been deposited, the polyimide is etched after which the layer of passivation is etched. The difference in sequence is significant because the instant invention first provides protection to the interconnect lines after which a bonding pad is created.

Fu et al. creates a bonding pad by first creating an opening in the layer of passivation, thereby exposing the bonding pad, after which a layer of polyimide is deposited. The layer of polyimide contacts the surface of the bonding pad, the layer of polyimide is etched thereby again exposing the bonding

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pad. The etch of the polyimide leaves polyimide in place over the surface of the bonding pad (Fu et al., col. 6, line 1 e.a.) which is further removed with an additional step of oxide ashing (Fu et al., see table in col. 6, lines 6-14).

What makes the instant invention unique and therefore patentable over Dass et al. in view of Fu et al. is that neither one of these two inventions addresses the creation of a bond pad that has been provided over a semiconductor surface over which a network of interconnect traces has also been provided. The bond pad can be accessed (exposed), leaving the interconnect traces covered and protected.

Prior art processing requires, in order to achieve this objective, the application of layers of photoresist with the potential of forming deposits of photoresist in keyholes between adjacent layers of interconnect traces, leading to the (potentially catastrophic) results that have been highlighted above. The invention eliminates negative effects previously created in exposing a bond pad, pad 14, Fig. 9 of the invention, which is created on a surface over which also interconnect traces, lines 12, Fig. 9, have been created, as further specified in claims 1 and 20 of the invention.

While applicant acknowledges the teachings of Dass et al. and Fu et al. as cited by the Examiner, and although applicant does not necessarily agree that the Examiner's arguments show sufficient and proper basis for suggestion or motivation to modify or combine Dass et al. with Fu et al., applicant nonetheless also asserts that there is absent within the portions of Dass et al. and Fu et al. of any combination thereof, as cited by the Examiner, an express or inherent teaching of each and every limitation within applicant's invention as taught and claimed within claims 1 and 20 and the supporting dependent claims of the invention.

It would not be obvious to combine the teachings of Dass et al. with those of Fu et al., since there is no suggestion or motivation in the teachings of any of the patents of the present invention. Contrary to the Examiner's assertion that the method of Fu et al. can be combined with the method of Dass et al. for forming bonding pads, neither one of these inventions addressed exposing of a bonding pad that is created over the same surface over which also interconnect traces have been created. The invention is believed to be patentable over the prior art cited, as it is respectfully suggested that the combination of these various references cannot be made without reference to Applicant's own invention. Neither one of these inventions

therefore, taken alone or in combination, address the problems of surface damage to the passivation layer of interconnecting metal lines, the problem of providing a surface stress buffer over a pattern of interconnect lines while not having to remove photoresist, the problem of SOG planarization in creating interconnect traces in combination with bonding pads (prior art typically uses a layer of SOG to avoid key hole formation, see element 30, Fig. 7), the problem of SOG surface cracking and delamination (a prior art problem for applications where a bond pad and interconnect traces are provided over the same surface, see Fig. 7 of the instant invention), the problems of an additional polyimide process to reduce stress impact on the surface of the passivation layer of the bonding pad and the problems of keyhole formation.

Applicant has claimed his process in detail. The processes of the invention, as claimed in claims 1 and 20, are both believed to be novel and patentable over Dass et al. in view of Fu et al., because there is not sufficient basis for concluding that the combination of claimed elements would have been obvious to one skilled in the art. That is to say, there must be something in the prior art or line of reasoning to suggest that the combination of these various references is desirable. We believe that there is no such basis for the combination.

In light of the foregoing response, applicant respectfully requests that the Examiner's rejection of claims 1-25 and 27-30 under 35 U.S.C 103(a) as being unpatentable over Dass et al. (US Patent 6,143,668) in view of Fu et al. (US Patent (5,807,787) be withdrawn.

Other Considerations

No new independent or dependent claims have been written as a result of this office action, no new charges are therefore incurred due to this office action.

SUMMARY

The invention teaches the deposition of a pattern of interconnecting lines and bond pads. Passivation layers are deposited over this metal pattern. A layer of photosensitive polyimide is deposited over the passivation layers. This layer of photosensitive polyimide is patterned, exposed and developed, the passivation layer is patterned and etched to expose the underlying bonding pads. The remaining polyimide is cured and cross-linked and remains in place to serve as a buffer during further device packaging.

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It is requested that should Examiner not find the claims to be allowable that he call the undersigned Attorney at his convenience at 845-452-5863 to overcome any problems preventing allowance.

Respectfully submitted,

A handwritten signature in black ink, appearing to be 'S. B. Ackerman', written in a cursive style.

Stephen B. Ackerman (Reg. No 37,761)